tise. An irregular practitioner attempted to evade this legal requirement, and was prosecuted. The case, being decided adverse to him, was finally carried to the Supreme Court of the United States on the ground that the act was invalid. This court sustained the lower courts in the following opinion: "The power of the State to provide for the general welfare of its people authorizes it to prescribe all such regulations as may be necessary to secure the people against the consequences of ignorance and incapacity as well as deception and fraud. One means to secure this end is the method adopted by the State of West Virginia. If the means adopted are appropriate to the calling or profession, and obtainable by reasonable study and application, no objection to their validity can be raised."

CONTAGIOUSNESS OF CONSUMPTION. — Mr. MacMullen, in the *Australasian Medical Gazette*, calls attention to the danger to which healthy travellers are subjected by consumptives. To illustrate this danger, he narrates a case in which a healthy man, on the voyage from London to Australia, was placed in the same stateroom with a consumptive in search of health. Now that consumption is regarded as a communicable disease, there is no longer excuse for this commingling of well and sick in such confined quarters as a ship's stateroom. Steps should be taken by the owners of steamships and other vessels to separate those who are so unfortunate as to have consumption, from those that are healthy, to the degree, at least, that the unsuspecting traveller would not be required to breathe the air impoverished and possibly infected by an invalid suffering from pulmonary consumption.

DOCTORS ADVERTISING. — The Board of Health of Illinois a few months ago revoked the license of H. G. Wildman, a physician, the chief charge being that he had overstepped the ethics of the profession by advertising his success and skill in newspapers. Dr. Wildman then appealed the case to Gov. Oglesby, and he rendered his opinion a few days since, reversing the decision of the Board of Health, and claiming that a physician should not be debarred from practice because he advertises what he can do and has done. Dr. Wildman expends over forty thousand dollars yearly in advertising in papers all over the Union, and several of the Illinois papers went on his bond in the action.

PUBLIC MEDICAL LIBRARIES. — In the proceedings at the reception given to Dr. Oliver Wendell Holmes, says the *New York Medical Record*, on the occasion of his presenting his library to the Boston Medical Library Association, Dr. R. M. Hodges, president of the association, gave some facts regarding the public medical libraries of this country. "First," he said, "in point of time, is the library of the Pennsylvania Hospital, founded in 1760; second, that of the College of Physicians in Philadelphia, founded in 1788; third, the New York Hospital Library, in 1796, etc. Of course, the library of the surgeon-general's office has surpassed in size all these, having a large annual appropriation and a magnificent librarian. Next in rank comes the library of the College of Physicians; next, that of the Academy of Physicians; and our library comes fourth in rank. After that come the Medical Department of the Public Library of Boston, and the New York Hospital Library. In other words, although the youngest of these seven libraries, ours has already passed three of them. We have nearly twenty thousand volumes."

DANGER IN THE POSTAGE-STAMP. — The *Sanitary News* calls attention to the fact that a postage-stamp may in various ways convey contagion. One of the simplest and most plausible is that in which a postage-stamp, partially attached to a letter to pay return postage, is sent by a person infected with some disease to another person. The disease is transferred, in the first place, to the adhesive stamp through the saliva, and in being attached to the letter by the receiver the poison may be transmitted to him in turn through the saliva. Another cause may be the infection of the stamp with disease germs. The stamp, having been exposed in a room where a diseased person lies, may become slightly moistened, and thus retain the germ. That this is true can be proved very simply by a microscopical examination. We often see a person holding change for a moment in the mouth, probably not knowing that investigation has shown that disease germs can be carried by money. If one could see through what hands the money has passed, he would hesitate before using such a third hand. Silver money is as bad as paper money; but, while many would hesitate to hold a dirty bank-note in their mouth, they think that a silver piece, because bright, is apparently clean.

SANITARY PLUMBING. — In speaking of the effects of sanitary plumbing, the *Sanitary News* says, "Dr. A. R. Carter, of the health department of Baltimore, has published some interesting statistics in regard to the effects of sanitary plumbing. He says that during a period of fifty-four years, from 1830 to 1883 inclusive, there were in that city 12,197 deaths from scarlet-fever, being an average of 226. In the last of those years there were 334 deaths. But the city council then passed an ordinance regulating plumbing, and in the years since, there has been a remarkable decrease in the mortality from scarlet-fever. In 1884 there were 104 deaths; in 1885, 67; in 1886, 32; and in 1887, 36; making a yearly average of 60, but with a plain tendency to decrease. The yearly average of deaths from diphtheria has in the same way diminished from 469 to 234." This kind of reasoning is, in our judgment, very fallacious. If the diminution of diphtheria in Baltimore is to be attributed solely to the improvement in plumbing, why did not the same result take place in New York and Brooklyn, where the improvement in plumbing has been most marked since 1882? In that year in New York there were 1,009 deaths from diphtheria; in 1884, 1,090; 1885, 1,325; 1886, 1,727; 1887, 2,167. In Brooklyn in 1883, 409 deaths occurred from this disease; in 1884, 385; 1885, 519; 1886, 782; and in 1888, 984. So far as scarlet-fever is concerned, the statistics of Brooklyn show no such marked difference in the various years as could be attributed to the plumbing. Thus in 1883 there were 505 deaths from this disease; in 1884, 218; 1885, 363; 1886, 340; and in 1888, 475. In New York there was a notable decline from 2,066 deaths in 1882, to 744 in 1883, which could not be attributed to improvements in plumbing. Since that time the number of deaths has not been as high, but the diminution cannot, we think, be traced to the better plumbing. We do not wish to be understood as disbelieving in the value to life and health of good plumbing, — on the contrary, we regard it as one of the most important factors in the preservation of health, — but we do not think it the only factor, and believe it to be a mistake to attribute the reduction of contagious disease in any small series of years to a single cause.

ELECTRICAL NEWS.

Hertz's Researches on Electric Oscillations.[1]

AFTER proving the existence of displacement currents in dielectrics, Hertz turned his attention to the propagation of waves in wires. To investigate this phenomenon, he used the apparatus shown in Fig. 9 (Fig. 11 in article). Here the primary circuit consisted of the two brass plates AA', connected by a conducting wire in which was an air-space. The secondary used was either B or C, a rectangle and circle of wire respectively, the periods of which were equal to that of the primary circuit, — about .000000014 of a second. The conducting plate P was placed behind and close to A, and a wire was taken from it in the direction shown, passed through a window, and at a distance of 60 metres was buried in the ground. Now, when the induction-coil is working, and oscillations occur in the primary circuit, disturbances are caused in the circuit Pmn, because of the induction of A upon P; and the period of this disturbance is of course equal to that of the primary. If the wire mn were short, there would be danger of disturbances from reflected waves, but 60 metres was found to be a sufficient length to obviate this.

When electrical waves pass through the wire, we should find loops and nodes, as in any other form of oscillation. To test this, secondary circuits whose periods were approximately that of the primary were brought close to the wire, and were moved along it, the result being noticed at different distances. As the secondary passed along, points of maximum and minimum effect were observed at regular intervals. The results are interesting. In the first place, the distances of minimum effect were — 0.2 metres,

[1] Continued from No. 314.

2.3 metres, 5.1 metres, and 8 metres; and in another experiment, —.1 metres, 2.8 metres, and 5.5 metres. The half wave-length, then, cannot be far from 2.8 metres, which would give, taking the period as .000000014 of a second, a velocity of propagation of 200,000 kilometres a second, — a result which lies between Fizeau and Gounelle's values of 100,000 kilometres for iron and 180,000 kilometres for copper, and Siemens's results, which gave from 200,000 to 260,000 kilometres per second for the volocity in iron wire. Another important point is, that, if the copper wire be replaced by one of different metal, the nodal points remain fixed, — that is, the velocity does not change, — and the same is true when the diameter of the wire is changed. This result is striking,

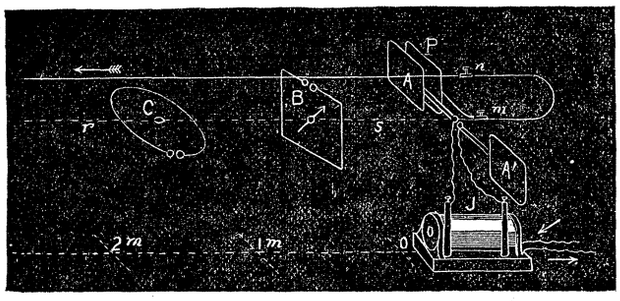

FIG. 9.

especially as showing that at such short periods the magnetic properties of iron wire have very little effect on the phenomenon.

Now, it is evident that a secondary circuit, such as *B*, Fig. 9 (Fig. 11 in paper), is subjected to two actions, — the action of the current in *mn*, and the direct action of the primary. If we obtain for any position of *B* a certain result, due to the combined action, and if, keeping the direction the same, we shift *B* along the wire a distance corresponding to one wave-length, then, provided the direct disturbance travelled with the same velocity as that along the wire, we should have a result of the same character as at first: if the actions were primarily in the same direction, they would still be so; if they at first opposed, they would still oppose one another. If, however, the actions travelled with un-

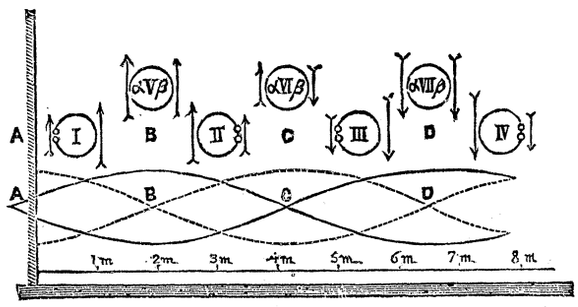

FIG. 10.

equal velocities, they would change their relative directions as the secondary was shifted along the wire, — slowly if the velocities were nearly alike, faster if they differed considerably. This is the result which Hertz obtained; the change of sign taking place, when the observations were at a considerable distance from the primary, in a distance of 7.5 metres, — a result which would give for the velocity in air a value equal to that in the wire multiplied by the ratio of 7.5 to 7.5 — 2.8, or 320,000 kilometres per second. Considering the very rough methods of experiment, this agrees very well with the velocity of light, which is approximately 300,000 kilometres per second.

But in this experiment a very important fact was developed. While the change of sign took place in a distance of 7.5 metres at points considerably removed from the primary, yet near the primary the change of sign was in a much shorter distance. Now, we have seen that near the primary the electro-static effects are of the greater importance, while at a distance from it the electro-dynamic actions can alone be considered. It would seem, then, that electro-static actions are propagated with greater velocity than electro-magnetic. It is hard to say from Hertz's results whether the velocity is infinite, since at a distance of 2.8 metres — the half-length of a wave on the wire — the magnetic effects are already of considerable importance. Still it seems fairly well proved that static and magnetic actions are propagated with different velocities, the latter being approximately that of light.

After this experiment, Hertz attempted to obtain evidences of the reflection of electro-magnetic waves from conducting surfaces. To do this, he placed the apparatus in a room whose dimensions were 15 metres in length, by 14 metres in width, by 6 metres high. There was a row of iron columns in the room, which cut off part of the available space, so that the width that could be utilized was reduced to 8.5 metres. All of the gas-fixtures having been removed, one wall of the room was prepared as a reflector by hanging on it a sheet of zinc, which was carefully attached to the gas-pipes and water-pipes. The primary circuit was arranged in a vertical position; the secondary was fitted so it could be moved into any position, this being usually accomplished by hand, although the body of the observer exerted a slight influence on the results. On placing the secondary in different positions between the primary circuit and the wall, results were obtained which are shown in Fig. 10 (Fig. 12 in article). With the secondary in the positions *I*, *II*, *III*, and *IV*, at distances from the wall shown by the scale, the strongest sparks were obtained when the air-space was in the position shown. At *V*, *VI*, and *VII* the same sparks occurred with the air-space at either side. This can be accounted for by supposing the waves to be those shown in the figure, the vibrations from the primary being reflected from the wall. Determining the length of the wave in this way, and assuming that they travel with the velocity of light, we obtain a period of .000000001 55 for the oscillations, instead of the .000000014 calculated from the dimensions of the circuit.

Such, in brief, are the most important of the results obtained by Hertz. He has developed a new experimental method, which in his own hands, and those of a number of physicists who are without doubt working now on the subject, will greatly extend our knowledge of what takes place in the vicinity of varying electric currents, and which will modify our views on the nature of electric actions. So far Hertz has shown that oscillations of short period can be practically obtained and experimented upon, and he has developed a method of investigation by means of a secondary circuit of a period equal to that of the vibration. He has shown, that, of the electro-static and electro-magnetic phenomena that accompany an oscillation, the former is of great importance near the oscillating current, but rapidly die away as the distance increases. He has shown that dielectrics have magnetic effects when placed near a conductor carrying an oscillating current, thus making more than probable Maxwell's hypothesis of "electric displacement." The velocity of a wave along a wire was determined, and from this the velocity of the electro-magnetic and electro-static waves in air were experimented upon. The former was found to be approximately that of light; the latter was much greater, but it was not possible to determine whether it was infinite. Lastly, electro-magnetic waves were reflected from a conducting surface, and their wave-length determined by the interference of the direct and reflected waves.

Hertz's work has put Maxwell's electro-magnetic theory of light on a firm basis, and has added experimental evidence to what was, after all, only an hypothesis.

ELECTRICITY AND LIGHT. — At a meeting of the Berlin Physical Society, Dec. 14, 1888, Professor von Helmholtz, the president, gave an account of a paper by Professor Hertz, which he had communicated the day before to the Berlin Academy. It contained a description of further experiments on electro-dynamic waves, and their analogy with waves of light. Weak induction discharges between small metallic cylinders with rounded ends were employed, and a similar apparatus for the detection of the electro-dynamic waves. The action was not propagated more than 2 or 3 metres through space; when it fell on a metallic surface, it was reflected, interference phenomena were observed, and from these the length

of half a wave was found to be 30 centimetres. When a metallic parabolic mirror, 1 metre across its opening, was placed behind the apparatus used to produce the discharge, the action was propagated to a distance of 8 metres; and the action was greatly increased when a second concave mirror was placed behind the receiving apparatus. When a conductor was interposed, the action ceased, while non-conductors allowed the waves to pass. By interposing perforated metallic screens, it was found that the waves are propagated in straight lines; the waves passed through a dry wooden partition. Polarization of the waves could be determined in several ways. When the receiver was placed at right angles to the apparatus producing the waves, no action between them could be detected, the vertically produced waves not being picked up by the horizontally placed receiver. When the two pieces of apparatus were placed parallel to each other, and a wooden cube, with a number of insulated metallic wire rings wrapped round it, was placed in the path of the electro-dynamic waves, it produced the same effect as does a tourmaline plate on polarized light. When the wires were vertical, — that is to say, parallel to the exciting apparatus, — the action was not propagated through the cube; but it was, on the other hand, when the wires were horizontal. When the receiver with its mirror was placed horizontally, so that it did not record any action as reaching it, and the wire arrangement described above was placed in the path of the waves, no change took place in the receiver when the wires on the cube were either vertical or horizontal; but the receiver was affected when the wires were placed at an angle of 45°. The laws of reflection of electro-dynamic waves at metallic surfaces were found to be the same as those for the reflection of light at plane mirrors. Finally, Professor Hertz has determined the refraction which the waves undergo in a prism made of pitch, and finds that the refractive index of this substance for electric waves is 1.68. Dr. Ritter demonstrated by experiments the action of the ultra-violet rays of light on electric discharges in accordance with the experiments of Hertz, Wiedemann, and Eberts.

LIGHT MOTORS FOR AERONAUTIC EXPERIMENTS. — M. Trouvé has constructed several small and extremely light motors of the Gramme and Siemens type, in order to carry out some aeronautic experiments. One of these motors, while only weighing about three ounces, is capable of developing .026 brake horse-power. All the parts of the machine are of aluminum with the exception of the magnets. This motor, which could be contained in a box 1.2 inches each way, is able to lift itself twenty-five yards a second by means of a wire and a fixed support. A one-horse-power motor constructed on the same lines would weigh barely eight pounds. When furnished with a light screw, and attached to the arm of a balance, the motor is able to lift its whole weight, when connected with a source of electric energy equal to forty watts. In order to facilitate his experiments, M. Trouvé places his motor at one end of a long lever capable of a vertical and horizontal movement about its centre, the electrical connections being made with the motor through the lever and its supports.

IMPORTANT PATENT DECISION. — In England the court of appeals has just handed down its decision reversing the finding of the lower court in the Edison incandescent lamp patent case. The case had been decided against Edison, principally on the ground of insufficient specification. This last decision upholds the Edison patents, and puts the Edison Company in England in the same position that it enjoys in Germany, where the patents have been uniformly upheld.

NOTES AND NEWS.

THE American Association for the Advancement of Science will meet at Toronto, Aug. 27 to Sept. 3; the first general session to be held on Aug. 28; the council meeting, on the 27th.

— The thirteenth anniversary of the Johns Hopkins University will be commemorated on Friday, Feb. 22, 1889. The public exercises of the day will be held in the Mount Vernon Place Methodist Episcopal Church at eleven o'clock. The public are invited to attend, and no tickets of admission will be required. The exercises in the church will close before one o'clock. The trustees, faculty, alumni, students, and gentlemen personally invited, will assemble at the university at half-past ten o'clock, and proceed in a body to the church, where seats will be reserved for them. The alumni of the university will have a social gathering with a luncheon after the close of the exercises in the church. The physical laboratory will be thrown open from eight to ten o'clock in the evening to members of the university and their friends, and the chief instruments and pieces of apparatus will be shown to visitors. Professor Rowland will make an address to physicists in the hall of the physical laboratory at half past four o'clock, on "Modern Views with Respect to Electric Currents." Specials cards of admission will be required. Right Rev. Henry C. Potter, Bishop of New York, preached the annual sermon before the Christian Association of the university in St. Paul's Church (corner of Charles and Saratoga Streets) on Sunday, Feb. 17, at 8 P.M.: subject, "The Mastery and Mastering of Circumstances." All members of the university were invited to attend. The University Glee Club gave a concert in the Lyceum Theatre on Tuesday, Feb. 19, at 8 P.M.: tickets, fifty cents. The Athletic Association gave a gymnastic exhibition in the gymnasium on Thursday, Feb. 21, at 8 P.M. Tickets (fifty cents each) had to be obtained at the University Post-Office.

— At a meeting of the American Oriental Society, held at Philadelphia, October, 1888, Isaac H. Hall, Richard J. H. Gottheil, George F. Moore, Edward W. Hopkins, and Cyrus Adler were appointed a committee to obtain information respecting manuscripts that exist in America, written in the Oriental languages or connected with their study, with a view to the ultimate publication of a comprehensive catalogue of the same, in a worthy manner, and calculated to serve all the useful purposes of the Oriental catalogues of the great libraries of Europe. The manuscripts which are the subject of inquiry include all the ancient and modern languages and dialects of Asia, with those of Egypt and Ethiopia, whatever be the subject-matter of the manuscript, whatever be the character of the writing for elegance or negligence, whatever be the material upon which it is written, whatever be its state of preservation, or whatever be its length or size. The points of inquiry include the language of the manuscripts, if known; the style of writing, or the alphabet employed (as, if the manuscript be Arabic, whether in Cufic or Neskhi, etc.; if Turkish, whether in Greek, Arabic, or Armenian letters, etc.), and the material upon which written; the size and binding (or absence of binding); number of leaves, and other external particulars of the manuscript; or, if a roll, its dimensions, and the number and dimensions of its columns (of fragments, papyrus, etc., the mere dimensions); the history of the manuscript, as far as known, and how it came into its present hands; if the manuscript is in a public library, both its present catalogue marks, and information respecting any former labels, library marks, or notes of ownership (the latter, of course, are desired if the manuscript is in private hands); also the date of the manuscript, if known.

—The field-work of the irrigation survey of the arid region of the United States is being vigorously prosecuted in Colorado and New Mexico, notwithstanding many disadvantages arising from cold and stormy weather. From Colorado, Mr. W. D. Johnson, in charge, reports the completion of the Pueblo and Huerfano sheet in fifty-foot contours, and on a scale of two miles to the inch, and considerable work done on the Apishapa and Juniata sheets, all being in the Arkansas valley. Mr. Johnson's parties, living in tents, have experienced temperatures below zero, and encountered twenty inches of snow; but such attention has been given to the men, that, beyond a few frost-bites, no trouble has been experienced in prosecuting work on every day not actually stormy. Work in New Mexico on the Lower Rio Grande has been commenced; Mr. R. Henry Phillips, in charge, reporting the arrival of his party at El Paso, and the occupancy of points connecting this work with the base-line measured near Fort Bliss in 1878 by the United States Engineers.

—Mr. Edwin Chadwick, the pioneer of sanitary reform in England, and indeed throughout the world, will, on the anniversary of his ninetieth birthday, March 2, be presented with a congratulatory